

Name: \_\_\_\_\_

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1. (10 pts.) When a 9.55 g sample of solid sodium hydroxide dissolves in 100.0 g of water in a coffee-cup calorimeter, the temperature rises from 23.0 °C to 47.4 °C.

constant  
P calorimeter



How much heat is released by the solution process? Assume the specific heat of the solution is 4.184 J/(g · °C). Calculate the  $\Delta H$  (in kJ/mol of NaOH) for the solution process.

$$m_{\text{soln}} = 9.55 \text{ g} + 100.0 \text{ g} = \underline{109.55 \text{ g}}$$

$$\Delta T = 47.4^\circ\text{C} - 23.0^\circ\text{C} = 24.4^\circ\text{C}$$

$$q_{\text{rx}} = -m_{\text{soln}} \times C_s \times \Delta T$$

$$= -(109.55 \text{ g} \times 4.184 \frac{\text{J}}{\text{g} \cdot ^\circ\text{C}} \times 24.4^\circ\text{C})$$

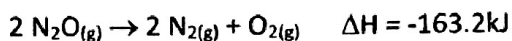
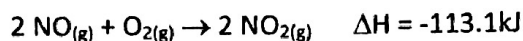
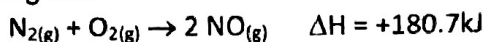
$$q_{\text{rx}} = \underline{-11,183.9 \text{ J}} = \underline{-1.12 \times 10^4 \text{ J}} = \underline{-11.2 \text{ kJ}}$$

$$\text{moles NaOH} = 9.55 \text{ g NaOH} \left( \frac{1 \text{ mol NaOH}}{40.00 \text{ g NaOH}} \right) = \underline{0.23875 \text{ mol NaOH}}$$

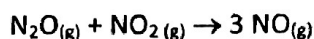
a) constant P,  $\Delta H = q_p$

$$\Delta H = \frac{-11.2 \text{ kJ}}{0.239 \text{ mol}} = -46.8 \frac{\text{kJ}}{\text{mol}}$$

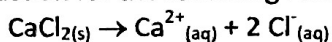
2. (10 pts) Given the following data



use Hess's law to calculate  $\Delta H$  for the following reaction:



3. (5pts) Determine the heat of reaction for the following reaction:



Is the reaction endothermic or exothermic? Why?

| Substance:              | $\Delta H_f^\circ$ |
|-------------------------|--------------------|
| $\text{CaCl}_{2(s)}$    | -795.8 kJ/mol      |
| $\text{Ca}^{2+}_{(aq)}$ | -543.0 kJ/mol      |
| $\text{Cl}^{-}_{(aq)}$  | -167.2 kJ/mol      |

$$\begin{aligned} \Delta H_{rxn}^\circ &= \sum n \Delta H_{f, \text{prod}}^\circ - \sum n \Delta H_{f, \text{react}}^\circ \\ &= [(1 \text{ mol} \times -543.0 \text{ kJ/mol}) + (2 \text{ mol} \times -167.2 \text{ kJ/mol})] \\ &\quad - (1 \text{ mol} \times -795.8 \text{ kJ/mol}) \end{aligned}$$

$$\Delta H_{rxn}^\circ = \underline{\underline{-81.6 \text{ kJ}}}$$